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EXAMINER	
NGUYEN, TU MINH	
ART UNIT	**PAPER NUMBER**
3748	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/188,190	Applicant(s) Kaneko et al.
	Examiner Tu M. Nguyen	Art Unit 3748

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) ☒ Responsive to communication(s) filed on *Jan 7, 2004*.

2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

4) ☒ Claim(s) *1 and 3-23* is/are pending in the application.

4a) Of the above, claim(s) _____ is/are withdrawn from consideration.

5) ☐ Claim(s) _____ is/are allowed.

6) ☒ Claim(s) *1 and 3-23* is/are rejected.

7) ☐ Claim(s) _____ is/are objected to.

8) ☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

9) ☐ The specification is objected to by the Examiner.

10) ☒ The drawing(s) filed on *Oct 2, 2002* is/are a) ☒ accepted or b) ☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13) ☒ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a) ☒ All b) ☐ Some* c) ☐ None of:

1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

*See the attached detailed Office action for a list of the certified copies not received.

14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

a) ☐ The translation of the foreign language provisional application has been received.

15) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s). _____
4) ☐ Interview Summary (PTO-413) Paper No(s). _____
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

1. This Office Action is in response to an Applicant's Request for Continued Examination (RCE) filed on January 7, 2004.

Per instruction from the RCE, an Applicant's Amendment filed on November 7, 2003 has been entered. Claims 1, 21, and 22 have been amended. Overall, claims 1 and 3-23 are pending in this application.

Drawings

2. The formal drawing of Figure 5 filed on October 2, 2002 has been approved for entry.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office Action:

> A person shall be entitled to a patent unless --
>
> (e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.
>
> The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act of 1999 (AIPA) do not apply to the examination of this application as the application being examined was not (1) filed on or after November 29, 2000, or (2) voluntarily published under 35 U.S.C. 122(b). Therefore, this application is examined under 35 U.S.C. 102(e) prior to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

4. Claim 22 is rejected under 35 U.S.C. 102(e) as being anticipated by Hepburn et al. (U.S. Patent 5,974,788) (Hepburn'788).

As shown in Figure 1, Hepburn'788 discloses an exhaust gas purifying apparatus of an internal combustion engine, comprising:

- a light-off catalyst (26) provided in an exhaust passage and having a O_2 storage capability such that the light-off catalyst passes, therethrough, at least CO in an exhaust gas to a downstream side of the light-off catalyst when the internal combustion engine is operating under a condition where the oxygen concentration of the exhaust gas is reduced (lines 44-52 of column 4 and line 63 of column 3 to line 10 of column 4);

- exhaust gas purifying means (32) provided in the exhaust passage at a downstream position of and in series with the light-off catalyst, the exhaust gas purifying means having a NO_x catalyst (a NO_x trapping material) for adsorbing NO_x in an exhaust gas when an air-fuel ratio of the exhaust gas is lean and releasing the adsorbed NO_x in an exhaust gas when the oxygen concentration of the exhaust gas is reduced, the exhaust gas purifying means further having a three-way catalyst (a noble metal) that reacts with the released NO_x (purifying means (32) in Hepburn'788 removes HC, CO, and NO_x in the exhaust gas at stoichiometric or slightly rich condition (lines 13-18 and 39-48 of column 1)); and

- control means (20, 16) for switching an air-fuel ratio of the exhaust gas from a lean air-fuel ratio to a stoichiometric air-fuel ratio or a rich air-fuel ratio while maintaining temperature of the NO_x catalyst below a temperature in which SO_x is released (as indicated on line 64 of

column 2 to line 12 of column 3 and lines 27-42 of column 3, the engine air-fuel ratio is modulated with the cylinders operated lean for 10 events and then operated rich for 10 events to raise the NO_x catalyst to as high as 700°C below which trapped SO_x in the catalyst is released).

5. Claim 23 is rejected under 35 U.S.C. 102(e) as being anticipated by Murachi et al. (U.S. Patent 5,746,989).

As shown in Figure 1, Murachi et al. disclose an exhaust gas purifying apparatus of an internal combustion engine, comprising:

- a light-off catalyst (5) provided in an exhaust passage and having an O_2 storage capability such that the light-off catalyst passes, there through, at least CO in an exhaust gas to a downstream side of the light-off catalyst when the internal combustion engine is operating under a condition where the oxygen concentration of the exhaust gas is reduced (see line 66 of column 3 to line 8 of column 4) (light-off catalyst (5) has limited oxygen storage capability because when the engine air-fuel ratio is switched to fuel rich, much of HC and CO in the exhaust gas pass through the light-off catalyst (5) unoxidized (lines 29-38 of column 6));

- exhaust gas purifying means (9) provided in the exhaust passage at a downstream position of and in series with the light-off catalyst, the exhaust gas purifying means having a NO_x catalyst (alkaline earth metals such as barium) for adsorbing NO_x in the exhaust gas when an air-fuel ratio of the exhaust gas is lean and releasing the adsorbed NO_x when the oxygen concentration of the exhaust gas is reduced, the exhaust gas purifying means further having a

three-way catalyst (platinum) that reacts with the released NO_x (line 50 of column 4 to line 36 of column 5); and

- control means (20, 4) for repeatedly releasing NO_x adsorbed by the NO_x catalyst every first interval (2 minutes) and repeatedly releasing SO_x adsorbed by the NO_x catalyst every second interval (60 minutes) longer than the first interval (see Figure 5 and lines 43-64 of column 8, especially lines 57-60 of column 8).

6. Claims 1, 8-15, and 17 are rejected under 35 U.S.C. 102(e) as being anticipated by Hepburn (U.S. Patent 5,771,685) (Hepburn'685).

Re claim 1, as shown in Figure 1, Hepburn'685 discloses an exhaust gas purifying apparatus of an internal combustion engine, comprising:

- a light-off catalyst (26) provided in an exhaust passage and having a O_2 storage capability such that the light-off catalyst passes, therethrough, at least CO in an exhaust gas to a downstream side of the light-off catalyst when the internal combustion engine is operating under a condition where the oxygen concentration of the exhaust gas is reduced (as indicated on lines 6-9 of column 4, during a NO_x purge, CO from the engine passes through the light-off catalyst (26) and reacts in a reducing reaction with NO_x released from a NO_x catalyst);

- exhaust gas purifying means (32) provided in the exhaust passage at a downstream position of and in series with the light-off catalyst, the exhaust gas purifying means having a NO_x catalyst (an NO_x trapping material) for adsorbing NO_x in an exhaust gas when an air-fuel ratio of the exhaust gas is lean and releasing the adsorbed NO_x in an exhaust gas when the oxygen

concentration of the exhaust gas is reduced, the exhaust gas purifying means further having a three-way catalyst (a noble metal) that reacts with the released NO_x (the purifying means (32) of Hepburn'685 removes HC, CO, and NO_x in the exhaust gas at a rich condition (lines 60-63 of column 4)); and

- control means (20, 16) for recovering the NO_x catalyst by reducing the oxygen concentration in the exhaust gas such that the CO that passed through the light-off catalyst is introduced to the NO_x catalyst when a NO_x conversion efficiency of the NO_x catalyst is decreased and maintaining the reduced oxygen concentration until the adsorbed NO_x in the NO_x catalyst is released (as shown in Figure 7, when a NOx conversion or storage efficiency is less than a predetermined value (step 112 with YES answer), a lean time T1 is reduced (step 114), the engine is then run with a lean air-fuel ratio for the reduced lean time T1 during which NO_x in the exhaust gas is trapped and stored in the NO_x catalyst; after the time T1, a regeneration cycle with a rich air-fuel ratio is performed to purge NO_x trapped by the NO_x catalyst (steps 96 with YES answer, 98, 92 with NO answer, and 100)), calculating the NO_x conversion efficiency after the recovery (step 106), and regenerating the NO_x catalyst to release SO_x only when the NO_x conversion efficiency, calculated after the recovery, is less than a threshold value (step 112 with YES answer, step 90 with NO answer, and step 120; also see lines 13-21 of column 6).

Re claim 8, in the apparatus of Hepburn'685, the internal combustion engine is a spark ignition type four-cycle engine that operates on the four-stroke cycle consisting of a suction stroke, compression stroke, combustion/expansion stroke, and exhaust stroke.

Re claim 9, in the apparatus of Hepburn'685, the internal combustion engine is an in-cylinder injection type engine in which fuel is directly injected into a combustion chamber (lines 45-48 of column 2).

Re claims 10 and 11, the single catalyst of the exhaust gas purifying means (32) in the apparatus of Hepburn'685 includes a function of the three-way catalyst.

Re claim 12, the light-off catalyst (26) in the apparatus of Hepburn'685 includes a single catalyst that functions as the three-way catalyst (lines 54-56 of column 2).

Re claim 13, the exhaust gas purifying means (32) in the apparatus of Hepburn'685 further functions also as the NO_x catalyst.

Re claim 14, the light-off catalyst (26) in the apparatus of Hepburn'685 also functions as a SO_x catalyst to oxidize and convert SO_2 in the exhaust gas to a sulfate which can be absorbed by the exhaust gas purifying means.

Re claim 15, in the apparatus of Hepburn'685, the condition where the oxygen concentration of the exhaust gas is reduced includes a fuel rich operating condition (lines 60-63 of column 4).

Re claim 17, in the apparatus of Hepburn'685, the light-off catalyst (26) is provided in the exhaust passage immediately downstream of the internal combustion engine.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office Action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over Cullen et al. (U.S. Patent 5,746,049).

As shown in Figure 1, Cullen et al. disclose an exhaust gas purifying apparatus of an internal combustion engine, comprising:

- a light-off catalyst (26) provided in an exhaust passage;

- exhaust gas purifying means (32) provided in the exhaust passage at a downstream position of and in series with the light-off catalyst (26), the exhaust gas purifying means having a NO_x catalyst (a NO_x trapping material such as an alkali metal or an alkaline earth metal) for adsorbing NO_x in an exhaust gas when an air-fuel ratio of the exhaust gas is lean and releasing the adsorbed NO_x in an exhaust gas when the oxygen concentration of the exhaust gas is reduced, the exhaust gas purifying means further having a three-way catalyst (a noble metal such as platinum) that reacts with the released NO_x (purifying means (32) in Cullen et al. removes HC, CO, and NO_x in the exhaust gas at stoichiometric or rich condition (lines 37-39 of column 1 and lines 22-32 of column 1)); and

- control means (20, 16) for switching an air-fuel ratio of the exhaust gas from a lean air-fuel ratio to a stoichiometric air-fuel ratio or a rich air-fuel ratio while maintaining temperature of the NO_x catalyst below a temperature in which SO_x is released (as shown in Figure 6 and indicated on lines 29-54 of column 8, the engine air-fuel ratio is switched to fuel rich and a secondary air pump is utilized to maintain the NO_x catalyst within a temperature range which includes a threshold value (MAXIMUM TEMPERATURE) below which trapped SO_x in the catalyst is released and the catalyst does not suffer irreversible damage).

Cullen et al., however, fail to disclose that the light-off catalyst (26) has a low O_2 storage capability such that the light-off catalyst passes, therethrough, at least CO in an exhaust gas to a downstream side of the light-off catalyst when the internal combustion engine is operating under a condition where the oxygen concentration of the exhaust gas is reduced.

It is obvious to those with ordinary skill in the art that the light-off catalyst (26) in Cullen et al. is a relatively small catalyst with low O_2 storage capability as compared with the exhaust gas purifying means (32) and is located closer to an outlet of the engine where the exhaust gas temperature is still relatively high. Because of the low O_2 storage capability, the light-off catalyst is only able to purify a small amount of rich components (unburned HC and CO) in the exhaust gas when the engine is run with a fuel rich of stoichiometry, and passes the rest of rich components to the exhaust gas purifying means located downstream of the light-off catalyst.

9. Claims 3 and 4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hepburn'685 as applied to claim 1 above, in view of design choice.

The apparatus of Hepburn'685 discloses the invention as cited above, however, fails to disclose that an amount of oxygen absorbed on the light-off catalyst is not greater than about 150 cc per one-liter volume of the catalyst when measured by an oxygen pulse method and that an oxygen component stored in the light-off catalyst is not greater than about 25 gr per one-liter volume of the catalyst.

One having ordinary skill in the art of exhaust emission control would have recognized that the specification of the maximum volumetric or weighted amount of oxygen absorbed in a light-off catalyst would be a function of many variables such as the size of the light-off catalyst, engine size, engine operating conditions (load, speed, etc), air and fuel properties, capacity and size of a main catalyst, etc. Moreover, there is nothing in the record which establishes that the claimed maximum volumetric or weighted amount of oxygen absorbed in a light-off catalyst presents a novel of unexpected result (See *In re Kuhle*, 526 F.2d 553, 188 USPQ 7 (CCPA 1975)).

10. Claims 5, 16, and 18-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hepburn'685 as applied to claim 1 above.

Re claims 5, 16, and 18, the apparatus of Hepburn'685 discloses the invention as cited above, however, fails to disclose that the three-way catalyst of the exhaust gas purifying means (32) has an oxygen storage value greater than an oxygen storage value of the light-off catalyst

(26); and that the light-off catalyst mainly purifies HC in an exhaust gas emitted from the engine in a cold state.

It is obvious to those with ordinary skill in the art that the light-off catalyst (26) in Hepburn'685 is a relatively small catalyst with low oxygen storage capability as compared with the exhaust gas purifying means (32) and is located closer to an outlet of the engine where the exhaust gas temperature is still relatively high. In this way, the light-off catalyst (26) reaches an activation temperature at an earlier time in order to purify HC emitting from the engine in a cold state.

Re claims 19 and 20, in the apparatus of Hepburn'685, the light-off catalyst (26) includes a three-way catalyst having a function of an oxidizing catalyst (line 54 of column 2).

11. Claims 6 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hepburn'685 in view of official notice as applied to claim 5 above, and further in view of design choice.

The apparatus of Hepburn'685 discloses the invention as cited above, however, fails to disclose that an amount of oxygen absorbed on the three-way catalyst of the exhaust gas purifying means is not greater than about 150 cc per one-liter volume of the catalyst when measured by an oxygen pulse method and that an oxygen component stored in the three-way catalyst of the exhaust gas purifying means is not greater than about 25 gr per one-liter volume of the catalyst.

One having ordinary skill in the art of exhaust emission control would have recognized that the specification of the maximum volumetric or weighted amount of oxygen absorbed in the

exhaust gas purifying means would be a function of many variables such as the size of the exhaust gas purifying means, engine size, engine operating conditions (load, speed, etc), air and fuel properties, capacity and size of a main catalyst, etc. Moreover, there is nothing in the record which establishes that the claimed maximum volumetric or weighted amount of oxygen absorbed in the exhaust gas purifying means presents a novel of unexpected result (See *In re Kuhle*, 526 F.2d 553, 188 USPQ 7 (CCPA 1975)).

Response to Arguments

12. Applicant's arguments with respect to the references applied in the previous Office Action have been fully considered but they are not persuasive.

Re claim 22, in response to applicant's argument that Hepburn'788 fails to disclose "switching an air-fuel ratio of the exhaust gas from a lean air-fuel ratio to a stoichiometric air-fuel ratio or a rich air-fuel ratio while maintaining temperature of the NO_x catalyst below a temperature in which SO_x is released" (page 12 of Applicant's Amendment), the examiner respectfully disagrees. As shown in Figures 2-3 and indicated on lines 27-42 of column 3 (especially lines 40-42 of column 3), Hepburn'788 modulates the engine air-fuel ratio with the cylinders operated lean for 10 events and then operated rich for 10 events to raise the NO_x catalyst (32) to a temperature range of at least 650°C and below 700°C (i.e., $650°C \leq T < 700°C$) in which trapped SO_x in the catalyst (32) is released.

Re claim 23, in response to applicant's argument that Murachi et al. fail to disclose "a control means for repeatedly releasing NO_x adsorbed by the NO_x catalyst every first interval and repeatedly releasing SO_x adsorbed by the NO_x catalyst every second interval longer than the first interval" (pages 14-16 of Applicant's Amendment), the examiner again respectfully disagrees. As shown in Figure 5 and indicated on lines 43-64 of column 8, Murachi et al. have to wait 60 minutes from the last SO_x purge in order to begin purging SO_x again. During this 60 minutes of waiting, the NO_x purge is performed as many as 30 times because they only have to wait 2 minutes from the last NO_x purge before repeating with the next NO_x purge. Since 60 minutes is longer than 2 minutes, it is clear that Murachi et al. disclose "a control means for repeatedly releasing NO_x adsorbed by the NO_x catalyst every first interval and repeatedly releasing SO_x adsorbed by the NO_x catalyst every second interval longer than the first interval". And since the SO_x is not purged during these 30 times of purging NO_x, the SO_x release control and NO_x release control in Murachi et al. are independent from each other. Or in other words, in Murachi et al., it is possible to release NO_x even when the SO_x release control is not taking place.

Re claim 1, in response to applicant's argument that Hepburn'685 fails to disclose "calculating the NO_x conversion efficiency after the recovery", and "regenerating the NO_x catalyst to release SO_x only when the NO_x conversion efficiency, calculated after the recovery, is less than a threshold value" (pages 16-17 of Applicant's Amendment), the examiner again respectfully disagrees. As clearly shown in Figure 7, Hepburn'685 performs a NO_x recovery cycle and measures a rich time (TD) to purge NO_x from the NO_x catalyst (32) (step 100). Hepburn'685

then calculates the NO_x conversion efficiency after the recovery (step 106); and regenerates the NO_x catalyst to release SO_x only when the NO_x conversion efficiency, calculated after the recovery, is less than a threshold value (step 112 with YES answer, step 90 with NO answer, and step 120; also see lines 13-21 of column 6).

Communication

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Examiner Tu Nguyen whose telephone number is (703) 308-2833.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mr. Thomas E. Denion, can be reached on (703) 308-2623. The fax phone number for this group is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-1148.

Tu M. Nguyen

TMN

January 18, 2004

Tu M. Nguyen

Patent Examiner

Art Unit 3748